

Hydrologic Model Manager

Short Name	UCODE
Long Name	universal inversion code
Description	
Model Type	
Model Objectives	<p>UCODE performs inverse modeling, posed as a parameter-estimation problem, using nonlinear regression. Any application model or set of models can be used; the only requirement is that they have numerical (ASCII or text only) input and output files and that the numbers in these files have sufficient significant digits. Application models can include pre-processors and post-processors as well as models related to the processes of interest (physical, chemical, and so on). An estimated parameter can be a quantity that appears in the input files of the application model(s), or that can be used in conjunction with user-defined functions to calculate a quantity that appears in the input files. Observations to be matched in the regression can be any quantity for which a simulated equivalent value can be produced, and simulated equivalent values are calculated using values that appear in the application model output files and a set of additive and multiplicative functions. Prior, or direct, information on estimated parameters also can be included in the regression. Statistics are calculated and printed for use in (1) diagnosing inadequate data and identifying parameters that probably cannot be estimated; (2) evaluating estimated parameter values; (3) evaluating the model representation of the actual processes; and (4) quantifying the likely uncertainty of model simulated values.</p>
Agency Office	<p>International Ground Water Modeling Center of the Colorado School of Mines and U.S. Geological Survey</p>
Tech Contact	<p>Regional Research Hydrologist U.S. Geological Survey Box 25046, Mail Stop 413 Denver Federal Center Denver, CO 50225-0046</p> <p>http://water.usgs.gov/software/ucode.html</p> <p>OR</p> <p>Eileen Poeter, Co-Director IGWMC: International Ground-Water Modeling Center Dept. Geology and Geological Engineering, COLORADO SCHOOL OF MINES 1500 Illinois St., Golden, CO 80401 (303)273-3829 fax (303)384-2037 epoeter@mines.edu http://www.mines.edu/fs_home/epoeter/</p> <p>http://www.mines.edu/igwmc/freeware/ucode/</p>
Model Structure	<p>The nonlinear regression problem is solved by minimizing a weighted least-squares objective function with respect to the parameter values using a modified Gauss-Newton method. Sensitivities needed for the method are calculated approximately by forward or central differences, and problems and solutions related to this approximation are discussed in the documentation which is included as pdf files in the download.</p>
Interception	
Groundwater	
Snowmelt	
Precipitation	

Evapo-transpiration	
Infiltration	
Model Paramters	In UCODE, the term 'parameter' is reserved for the parameters of the application file that can be estimated by the regression. For UCODE input, see the section below entitled "Input Data Requirements".
Spatial Scale	Governed by the spatial scale of the application model(s).
Temporal Scale	Governed by the temporal scale of the application model(s).
Input Requirements	UCODE input includes (1) variables which control the calculation of sensitivities and the regression, (2) commands for executing the application model(s), (3) observation data used to estimate values of defined parameters, (4) information needed to substitute parameter values into application model input files, and (5) information needed to extract simulated values out of application model input files.
Computer Requirements	UCODE is intended for use on any computer operating system; it consists of algorithms programmed in perl, a freeware language designed for text manipulation, and Fortran90, which efficiently performs numerical calculations. UCODE has been tested extensively on Windows and Unix operating systems.
Model Output	Primary output is sensitivity of the observations to parameters and the estimated parameters that minimize the objective function. Other output includes statistics that describe how well the application models match the observations using the estimated parameters. Statistics are calculated and printed for use in (1) diagnosing inadequate data and identifying parameters that probably cannot be estimated; (2) evaluating estimated parameter values; (3) evaluating the model representation of the actual processes; and (4) quantifying the likely uncertainty of model simulated values.
Parameter Estimatr Model Calibrtn	As described above, this code is a universal inversion tool that can be applied to any other model with text-based input and output, that can be run in batch mode.
Model Testing Verification	A test data set is included with the download. Exact comparison have been obtained between UCODE inversions of MODFLOW and MODFLOWP results, and UCODE has been tested on synthetic problems with known solutions.
Model Sensitivity	UCODE is used to determine sensitivity of other models to defined parameters.
Model Reliability	UCODE has been tested extensively as defined above and has been found to perform reliably.
Model Application	<p>UCODE was released one year ago and published applications are not yet common. UCODE is based on the same methods and ideas used to design the USGS computer program MODFLOWP (Hill, 1992), and some of the UCODE code is derived directly from MODFLOWP. Consequently, selected references for applications of MODFLOWP are listed here to assist users with the issues related to applying UCODE. Issues related to weighting of observations, interpretation of results, and appropriate procedures when the regression is not proceeding in an acceptable manner are the same for MODFLOWP and UCODE, and are presented by Hill (1998).</p> <p>Related references:</p> <p>The USGS references can be ordered from: U.S. Geological Survey Books and Open-File Reports Section Box 25425, Mail Stop 517 Federal Center Denver, CO 80225-0425 Anderman, E.R., Hill, M.C., Poeter, E.P., 1994, Two-dimensional advective transport in nonlinear regression - - Sensitivities and uncertainty of plume-front observations: in Warner, J. and others, eds, 1994 Ground Water Conference, Fort Collins, CO, Proceedings, p. 55-62 Anderman, E.R., Hill, M.C., Poeter, E.P., 1996, Two-dimensional advective transport in ground-water flow parameter estimation: Ground Water, 34(6): 1001-1009. Cooley, R.L. and Naff, R.L., 1990, Regression modeling of ground-water</p>

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Documentation	<p>Poeter, E.P. and M.C. Hill, 1998, Documentation of UCODE: A computer Code for Universal Inverse Modeling, U.S. Geological Survey Water-Resources Investigations Report 98-4080, 116 pp.</p> <p>Hill, M.C., 1998, Methods and guidelines for effective model calibration: U.S. Geological Survey, Water-Resources Investigations Report 98-4005.</p> <p>These are included as a pdf files in the download.</p>
Other Comments	
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